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Federal Communications Commission
Office of Secretary

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April 24, 1997

Mr. William F. Caton
Acting Secretary
Federal Communications Commission
1919 M Street, NW, Room 222
Washington, DC 20554

RE: CC Docket No. 96-45 - Universal Service

Dear Mr. Caton:

Attached is a paper on "Analysis of Benchmark Cost Proxy Model and Hatfield Release 3.1" that was prepared by Laurits R. Christensen, Mark E. Meitzen, Philip E. Schoech, A. Thomas Bozzo and Thomas J. Rutkowski, all of Christensen Associates, at the request of the United States Telephone Association (USTA). This paper evaluates the current generation of proxy cost models, (1) the Benchmark Cost Proxy Model (BCPM), sponsored by Pacific Bell, Sprint, and US WEST; and (2) Hatfield Version 3.1 (HM 3.1), sponsored by AT&T and MCI.

In accordance with Section 1.1206(a)(1) of the Commission's rules, two copies of this notice are being submitted to the Secretary of the FCC today. Please include it in the public record of the proceeding.

Respectfully submitted,

Porter E. Childers

Porter E. Childers
Executive Director
Legal and Regulatory Affairs

Attachment

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Analysis of Benchmark Cost Proxy Model and Hatfield Release 3.1

Laurits R. Christensen, Mark E. Meitzen, Philip E. Schoech,
A. Thomas Bozzo, and Thomas J. Rutkowski
Christensen Associates
April 23, 1997

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Laurits R. Christensen, Mark E. Meitzen, Philip E. Schoech,
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April 23, 1997

I. Introduction

Christensen Associates has been retained by the United States Telephone Association to evaluate the current generation of proxy cost models: the Benchmark Cost Proxy Model (BCPM), sponsored by Pacific Bell, Sprint, and US West; and Hatfield version 3.1 (HM3.1), sponsored by AT&T and MCI.[1] The current evaluation is a follow-up to our January 9, 1997 evaluation of the Benchmark Cost Model 2 (BCM2) and Hatfield version 2.2.2 (HM2.2.2).[2]

We compare the results of the new models to the previous versions of the models for the five states we analyzed in our previous report -- Arkansas, California, Texas, Utah, and Washington. We then focus on a detailed analysis and comparison of BCPM and HM3.1.

Table E.1 compares the average monthly cost per line of the various versions of the proxy models. A weighted average for the five states (with relative number of lines serving as weights) is also displayed. The results for Table E.1 are for runs using the default values of the respective models.

[1] The version of BCPM we examine in this analysis was released on February 22, 1997. The version of HM3.1 we examine in this analysis was released on March 3, 1997. Subsequently, Version 1.1 of BCPM was released on March 24, 1997. We have found that results from the March 24 release are so similar to the February 22 release that none of the analysis or conclusions in this paper would be affected by substituting the March 24 release.
[2] "Economic Evaluation of Proxy Cost Models for Determining Universal Service Support," Christensen Associates, January 9, 1997.

Included in the monthly cost per line figure are loop, switching, and overhead costs evaluated at their default values.[3]

Table E.1
Average Monthly Cost per Line

	AR	CA	TX	UT	WA	Wtd. Avg
Benchmark						
BCPM	$52.97	$28.78	$36.30	$36.42	$35.52	$32.62
BCM2	$40.97	$24.50	$29.98	$31.21	$29.41	$27.36
% Change	29%	17%	21%	17%	21%	19%
Hatfield						
HM3.1	$32.75	$16.65	$22.08	$24.55	$20.86	$19.35
HM2.2.2	$21.59	$14.89	$16.80	$20.43	$16.89	$16.00
% Change	52%	12%	31%	20%	24%	21%

Hatfield/Benchmark Differences

	AR	CA	TX	UT	WA	Wtd. Avg
HM3.1/ BCPM	-38%	-42%	-39%	-33%	-41%	-41%
HM2.2.2/ BCM2	-47%	-39%	-44%	-35%	-43%	-42%

Our analysis finds that the monthly cost per line has gone up by an average of approximately 20 percent over the five states for both models relative to their predecessors--i.e. BCPM vs BCM2 and HM3.1 vs HM2.2.2. This means the relative gap in monthly cost between the models remains essentially unchanged from the previous versions of the models. For BCPM, the increase is primarily due to an increase in investment per line relative to BCM2, which is attributable to increases in loop length and switching investment per line. For

[3]Transport and signaling costs are also included in the cost per line figures. HM3.1 explicitly models transport and signaling costs, while BCPM accounts for these costs with a factor applied to switching costs.

HM3.1, a majority of the increase is attributable to the inclusion of non-Bell territories in this release of the model.

Comparing the current versions of the models, BCPM and HM3.1, monthly cost per line estimated by HM3.1 is 41 percent lower, on average, than BCPM's estimates. This is the result of lower investment per line estimated by HM3.1 and conversion of these investments to annual (and monthly) costs[4] at a lower rate by HM3.1 relative to BCPM. We are able to identify differences in switching investment and structure sharing assumptions as major differences in investment between HM3.1 and BCPM. Across the five states, these two factors account for an average of 34 percent of the difference in annual cost between the two models. The difference in conversion of investments to annual costs accounts for an average of 51 percent of the difference in annual cost between the models across the five states. This is due to differences between the models in cost of capital, depreciation, capital structure, expenses and overhead allocations. Overall, we are able to account for an average of 85 percent of the difference in annual costs between the models across the five states.

II. Comparison of Current Models to Previous Versions of Proxy Models

BCPM vs BCM2. The reason that average monthly cost per line increased for BCPM relative to BCM2 can be traced to an increase in investment per line for BCPM. This is offset, to some extent, by a decline in the average

[4] Monthly costs are obtained by dividing annual costs by 12. Thus, conversion of investment to annual costs also determines monthly costs.

annual cost factor used in BCPM relative to that used in BCM2. Per-line switching investment has increased substantially, from an average of $116 per line in BCM2 to $325 per line in BCPM.[5] The magnitude of this increase is similar across all five states.

The increase in loop investment for BCPM is due to an increase in average loop length for BCPM relative to BCM2. Over the five states, average loop length increased 14 percent in BCPM relative to BCM2. The increases range from 5 percent in Arkansas to 17 percent in California and Washington. These increases are due to changes in CBG assignment from the nearest wire center in BCM2 to the serving wire center in BCPM.[6]

Offsetting the increase in investment, to some extent, is the fact that the BCPM translates investments into annual costs at a lower rate than BCM2. This is due to differences between the models in cost of money, depreciation, taxes, direct and indirect expenses, and overhead loadings. On average over the five states, the implicit annual cost factor (i.e., the rate at which investments are converted into annual costs) in BCPM is 10 percent lower than BCM2's factor.

In sum, the BCPM's increase in annual costs relative to BCM2 is due to a 32 percent increase in per-line investment and a 10 percent reduction in the average annual cost factor that converts investments into annual costs.

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[5] Switching also includes investment in transport facilities. As noted in fn. 3, BCM2 and BCPM do not explicitly model transport investment, but estimate it by applying a factor to switching investment.

[6] The assignment of CBG to serving wire center is based on the location of the centroid of the CBG relative to the wire center boundaries.

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HM3.1 vs HM2.2.2. The most obvious reason for the change in results between HM3.1 and HM2.2.2 is the inclusion of non-Bell territories in HM3.1. Over the five states, an average of 55 percent of the difference between HM3.1 and HM2.2.2 results is accounted for by the inclusion of non-Bell territory in HM3.1. The proportion ranges from 32 percent of the difference in California to 95 percent in Utah. This is illustrated in Table E.2, which presents monthly costs for HM3.1 on a statewide basis and for Bell territories only.

Table E.2
Percent of Monthly Difference Between HM3.1 and HM2.2.2
Accounted for by Inclusion of Non-Bell Territory

	AR	CA	TX	UT	WA	Wtd Avg
1. HM3.1 Overall	$32.75	$16.65	$22.08	$24.55	$20.86	$19.35
2. HM3.1 Bell Only	$25.27	$16.09	$18.79	$20.65	$18.32	$17.50
3. Difference: 1-2	$7.48	$0.56	$3.29	$3.90	$2.54	$1.85
4. Difference: HM3.1-HM2.2.2	$11.16	$1.76	$5.28	$4.12	$3.97	$3.36
3 as % of 4	67%	32%	62%	95%	64%	55%

On average, investment per line increases by 7 percent in HM3.1 relative to HM2.2.2, ranging from no increase in California to 51 percent in Arkansas. Loop investment per line increased by 9 percent on average, ranging from 5 percent in California to 41 percent in Arkansas. Switching investment per line increased by 2 percent on average. The changes ranged from a 14 percent decrease in California to an 83 percent increase in Arkansas.

On average, the implicit annual cost factor is 13 percent higher for HM3.1 than HM2.2.2. Combined with the average increase in per-line investment of 7 percent, this produces the increase in monthly cost per line of HM3.1 relative to HM2.2.2.

III. Differences in BCPM and HM3.1 Costs

Table E.3 restates the BCPM and HM3.1 monthly cost per line estimates from Table E.1 on an annual basis. The difference in per-line annual costs between BCPM and HM3.1 is due to differences in investment levels between the models and the rate at which these investments are converted to annual costs. Below, we analyze the factors which contribute to the lower HM3.1 annual costs which, on average, are 41 percent below BCPM's annual costs per line.

Table E.3
Total Annual Cost Per Line, BCPM and HM3.1

	AR	CA	TX	UT	WA	Wtd Avg
BCPM	635.64	$345.36	$435.60	$437.04	$426.24	$391.46
HM3.1	$393.00	$199.80	$264.96	$294.60	$250.32	$232.24
HM3.1/ BCPM	-38%	-42%	-39%	-33%	-41%	-41%

<u>Investment.</u> HM3.1 has lower per-line investment for both loop and switching categories. As documented in Appendix A, the difference in switch investment between the two models can be traced to the new switch cost equation used in BCPM. The difference in loop investment between the two models can be accounted for by the differences between the models in factors such as structure sharing, input price assumptions, loop length, and proportions

of aerial, buried and underground cable. Of these factors, we have been able to quantify the effect of differences in structure sharing assumptions.[7]

Both models now allow user-defined structure sharing assumptions. The BCPM default assumptions assign at least 75 percent of all structures costs to telephony, with the exception of poles, which are assigned 50 percent to telephony. The HM3.1 assignment of structures costs is more complex than HM2.2.2, but the default overall average percentage assigned to telephony is close to the previous 33 percent.

Table E.4 provides a summary of the proportion of the difference in total investment explained by differences in switching investment and structure sharing. On average, these two factors explain two-thirds of the difference in investment between BCPM and HM3.1--one third is due to BCPM's greater switching investment and one-third is due to differences in structure sharing assumptions between the models.

Annual Cost Factors. The translation of investments to annual (and monthly) costs accounts for 51 percent of the difference in monthly cost per line between BCPM and HM3.1. The implicit annual cost factors include an explicit annual capital charge factor (ACCF) that converts investments into annual

[7] There were significant differences in costs for digital loop carrier (DLC) systems and poles between the models. Although the costing of DLCs is not directly comparable between the models, by making some standardizing assumptions on these costs, we were able to explain an average of almost 27 percent of the difference in loop investment between BCPM and HM3.1. See Appendix C for details. We also analyzed the difference in investment due to difference between the models in the proportions of aerial, underground and buried cable. However, this difference turned out to produce insignificant differences in costs between the models.

capital costs; and annual expense and overhead allocations that are included in per-line annual costs.

Table E.4
Proportion of Difference in Total Investment Per Line
Accounted for by Switch Investment and Structure Sharing Assumption

	AR	CA	TX	UT	WA	Avg
Differences in Total Investment Per Line	$(701)	$(190)	$(389)	$(278)	$(364)	$(286)
Differences in Switch Investment Per Line	$88	$(123)	$(83)	$(35)	$(76)	$(98)
Loop Difference Due to Structures	$(163)	$(91)	$(101)	$(118)	$(99)	$(98)
% of Difference Due to Switch Investment	-13%	65%	21%	13%	21%	34%
% of Difference Due to Structure Sharing	23%	48%	26%	43%	27%	34%

**Difference stated as HM3.1 - BCPM

The annual cost factors for HM3.1 are an average 23 percent lower than those for BCPM. This is the result of substantially lower annual capital charge factors in HM3.1, and lower support expense and variable overhead loadings that depend on the resulting capital charges.

Table E.5 shows the difference in HM3.1 monthly costs when BCPM annual cost factors are used to convert HM3.1 investments to annual costs. The table provides a breakdown of the impact of differences in ACCFs and expense and overhead loadings on HM3.1's annual costs. The results of Table E.5 indicate that the annual capital charge factors account for an average of $3.28 of the $5.89 difference due to differences in annual cost factors (56 percent), with the amount highly variable across states.

Table E.5
Effect of BCPM Annual Cost Factors on HM3.1 Monthly Costs

	AR	CA	TX	UT	WA	Wtd Avg
Difference Due to ACF	$(5.40)	$(6.81)	$(4.71)	$(5.11)	$(5.70)	$(5.89)
Dollar Differences						
Due to Depr and Cost of Capital	$(5.80)	$(2.78)	$(3.79)	$(4.16)	$(3.54)	$(3.28)
Due to Expenses and Overheads	$0.40	$(4.03)	$(0.92)	$(0.95)	$(2.16)	$(2.61)
Percent of Difference						
Due to Depr and Cost of Capital	107%	41%	80%	81%	62%	56%
Due to Expenses and Overheads	-7%	59%	20%	19%	38%	44%

Summary. Average annual costs per line are an average of 41 percent lower for HM3.1 across the five states analyzed. This is due to HM3.1's lower investment per line, and lower annual cost factors. Table E.6 presents a breakdown of the factors we were able to attribute the difference to and the proportion of the difference they account for.

Table E.6
Percent of HM3.1 -- BCPM Difference Explained

	AR	CA	TX	UT	WA	Wtd Avg
Percent Explained By:						
Investment						
Switching	-8%	25%	13%	7%	11%	17%
Structures Sharing	15%	19%	16%	22%	15%	17%
Investment Subtotal	*7%*	*44%*	*29%*	*29%*	*26%*	*34%*
Annual Cost Factors						
ACCF	36%	25%	32%	39%	29%	28%
Expenses and Overheads	-2%	36%	8%	9%	17%	22%
ACF Subtotal	*34%*	*61%*	*40%*	*48%*	*46%*	*51%*
Total Explained	**41%**	**105%**	**69%**	**77%**	**72%**	**85%**

Of the difference in investment between the two models, we were able to identify differences in switching investment and structure sharing assumptions as significant factors. Together, these two factors account for an average of 34 percent of the difference between HM3.1 and BCPM, ranging from 7 percent in Arkansas to 44 percent in California. Other discrepancies in per-line investment between the models we were not able to quantify include differences in loop lengths and differences in input prices.[8]

The differences in model results due to annual cost factors account for an average of 51 percent of the difference in annual costs between BCPM and HM3.1, ranging from 34 percent of the difference in Arkansas to 61 percent of the difference in California. This difference can be decomposed into differences in the conversion of investments into annual capital charges (the annual capital charge factors), and differences in estimates of annual expenses and overhead loadings. We found that, on average, 28 percent of the overall difference between the two models was due to differences in annual capital charge factors that relate to difference in the weighted average cost of capital and asset lifetimes between the models. Differences in estimates of annual expenses and overhead loadings accounted for 22 percent of the difference in annual costs between the two models.

On average, these four factors accounted for 85 percent of the difference in per-line annual costs between BCPM and HM3.1. This ranges from a low of 41 percent in Arkansas to over 100 percent of the difference in California.

[8] As noted above, Appendix C also attempts to equalize assumptions on DLC costs between the two models. This factor also potentially explains a significant portion of the difference between the two models.

IV. Differences in Line and Household Estimates

Lines. Given the inclusion of non-Bell territories in HM3.1, the line counts for BCPM and HM3.1 should be comparable. However, on average over the five states, line counts for HM3.1 are 11 percent greater than those for BCPM. The BCPM residential line multiplier is based on the 1995 number of USF loops reported to NECA, less the estimated number of business lines. HM3.1 controls the model's estimated line counts to line counts for Tier 1 companies filing ARMIS reports, but does not control line counts for companies that do not report to ARMIS.

Table E.7
Estimated Number of Lines
(in thousands)

	AR	CA	TX	UT	WA	Average
BCPM	1,289	20,624	10,759	1,000	3,322	7,399
HM3.1	1,313	22,950	12,076	1,200	3,510	8,210
HM3.1/ BCPM	2%	11%	12%	20%	6%	11%

Therefore, statewide BCPM results should be more accurate because the totals are controlled to NECA reported line counts, while HM3.1 does not control estimates for non-Tier 1 companies. For ARMIS reporting companies, the HM3.1 results should be accurate because the results are controlled to actual reported totals.

Households. Given that both BCPM and HM3.1 employ a 1995 estimate of households, the numbers should be similar. However, as in the case of lines, the number of households differ by a significant amount between the two models. On average, the estimate of households is 23 percent greater for HM3.1 than it is for BCPM. In fact, it is 41 percent greater for California. The only state where the two estimates are close is Texas. Given that both models have used 1995 Census estimates, it is puzzling that the household estimates differ by so much. The reason for this discrepancy remains unknown.

Table E.8
Estimated Number of Households

	AR	CA	TX	UT	WA	Average
BCPM	942,872	11,033,168	6,684,245	608,219	2,089,800	4,271,661
HM3.1	1,067,300	15,511,770	6,663,537	819,197	2,278,001	5,267,961
HM3.1/ BCPM	13%	41%	0%	35%	9%	23%

V. Engineering Evaluation

Finally, we note that while comparison and analysis of proxy model results may lead to greater "proxy-to-proxy" consistency, external validation of the proxy models is an essential element in obtaining an adequate proxy model. External validation includes an engineering assessment of proxy model network design and an assessment of whether the costs produced by the proxy models comport with the expected economic costs of an actual market participant.

An engineering evaluation of the current versions of the proxy models, BCPM and HM3.1, has been recently performed by Price Technical Services, Inc. and Austin Communications Education Services, Inc (Price/Austin). Regarding the BCPM, the Price/Austin evaluation concluded that the BCPM satisfies substantially all the requirements of the Joint Board and that the flexibility of the model allows changes to reflect input values the FCC and the Joint Board believe to be appropriate.[9] The Price/Austin evaluation concluded that while HM3.1 is an improvement over HM2.2.2, there are several outstanding problems and shortcomings that preclude the use of HM3.0/3.1 in any real world design or cost analysis.[10]

VI. Conclusion

Significant differences still exist between the current versions of the proxy models, BCPM and HM3.1. Switch prices and structure sharing assumptions constitute the majority of the difference in investment between the two models. These differences account for a combined 34 percent of the difference in annual (and monthly) costs between BCPM and HM3.1. Differences relating to the cost of capital and depreciation account for 28 percent of the difference, and estimates of annual expense and overhead loadings account for 22 percent of the difference. On average, all of these factors combine to explain 85 percent of the difference in annual (and monthly) costs between the two models.

[9] "Engineering Evaluation of Cost Proxy Models For Determining Universal Service Support: Benchmark Cost Proxy Model," Price Technical Services, Inc., and Austin Communications Education Services, Inc., February 23, 1997, p. 19.
[10] "Engineering Evaluation of Cost Proxy Models For Determining Universal Service Support: Hatfield Model Version 3.0/3.1," Price Technical Services, Inc., and Austin Communications Education Services, Inc., March 17, 1997, p. 38.

EXECUTIVE SUMMARY

Significant differences still exist in engineering between the two models, particularly assumptions regarding the design of loops. The Price/Austin engineering assessment has determined that BCPM is closer to satisfying the FCC and Joint board standards.

Analysis of Benchmark Cost Proxy Model and Hatfield Release 3.1

Laurits R. Christensen, Mark E. Meitzen, Philip E. Schoech,
A. Thomas Bozzo, and Thomas J. Rutkowski
Christensen Associates
April 23, 1997

I. Introduction

Christensen Associates has been retained by the United States Telephone Association to evaluate the current generation of proxy cost models: the Benchmark Cost Proxy Model (BCPM), sponsored by Pacific Bell, Sprint, and US West; and Hatfield Release 3.1 (HM3.1), sponsored by AT&T and MCI. The current evaluation is a follow-up to our January 9, 1997 evaluation of the Benchmark Cost Model 2 (BCM2) and Hatfield Release 2.2.2 (HM2.2.2).[1]

First, we compare the results of the new models to the previous versions of the models for the five states we analyzed in our previous report--Arkansas, California, Texas, Utah, and Washington. This allows quantification of the changes made in the models. We then perform a detailed analysis and comparison of BCPM and HM3.1.

Our analysis finds that the monthly cost per line has gone up by an average of approximately 20 percent over the five states for both models relative to their predecessors. This means the relative gap in monthly cost between the models remains essentially unchanged from the previous versions of the models.

[1] "Economic Evaluation of Proxy Cost Models for Determining Universal Service Support," Christensen Associates, January 9, 1997.

For BCPM, the increase is primarily due to an increase in investment per line relative to BCM2, which is attributable to increases in loop length and switching investment per line. For HM3.1, a majority of the increase is attributable to the inclusion of non-Bell territories in this release of the model.

Comparing the current versions of the models, BCPM and HM3.1, monthly cost per line estimated by HM3.1 is 41 percent lower, on average, than BCPM's estimates. This is the result of lower investment per line estimated by HM3.1 and conversion of these investments to annual (and monthly) costs[2] at a lower rate by HM3.1 relative to BCPM. We are able to identify differences in switching investment and structure sharing assumptions as major differences in investment between HM3.1 and BCPM. Across the five states, these two factors account for an average of 34 percent of the difference in annual cost between the two models. The difference in conversion of investments to annual costs accounts for an average of 51 percent of the difference in annual cost between the models across the five states. This is due to differences between the models in cost of capital, depreciation, capital structure, expenses and overhead allocations. Overall, we are able to account for an average of 85 percent of the difference in annual costs between the models across the five states.

Finally, we note that while comparison and analysis of proxy model results may lead to greater "proxy-to-proxy" consistency, external validation of the proxy models is an essential element in obtaining an adequate proxy model. External

[2] Monthly costs are obtained by dividing annual costs by 12. Thus, conversion of investment to annual costs also determines monthly costs.

validation should include an engineering assessment of proxy model network design and an assessment of whether the costs produced by the proxy models comport with the expected economic costs of an actual market participant.

Section II compares the current version of the proxy models with their previous versions to identify sources of significant changes between versions of the respective models. Section III focuses on an analysis of the current versions of the models, BCPM and HM3.1 to determine where significant differences between the models still exist. Section IV compares household and line counts for the various versions of the models. Section V evaluates other aspects of the new models, including a comparison of Bell and non-Bell estimates. Finally, Section VI discusses the external validation of proxy models.

II. Comparison of Current Versions of Proxy Models with Previous Versions of Proxy Models

The BCPM is the successor to BCM2. The version of BCPM we examine in this analysis was released on February 22, 1997.[3] According to the BCPM sponsors, the following are among the changes that have been made to the model:[4]

- Annual cost factor inputs are better identified and are user-adjustable
- Expenses and other non-direct investments are stated on a per-line basis[5]

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[3] Version 1.1 of BCPM was subsequently released on March 24,1997. We have found that results from the March 24 release are so similar to the February 22 release that none of the analysis or conclusions in this paper would be affected by substituting the March 24 release.

[4] "Benchmark Cost Proxy Model Methodology," Pacific Bell, Sprint, and US West.

[5] While this is appropriate for estimating costs per line for universal service purposes, the per-line approach could not be used to attribute expenses to unbundled network elements.

- Information on input prices, forward-looking expenses and overheads are obtained from a survey of LECs (mostly large LECs have responded to date)
- Switch information is based on a survey of LEC switching costs
- Number of households is based on 1995 census estimates
- Structure sharing is possible and is user-adjustable
- Each CBG is associated with its serving wire center based upon the location of the centroid of the CBG

The following features are the same as the previous version, BCM2:

- CBGs are the primary geographic unit
- Households are uniformly distributed within CBG. Rural CBGs are reduced for areas with no road access
- Interoffice transport investment is computed as a factor based on switching investment

HM3.1 is the successor to HM2.2.2 (with Release 3.0 as an interim). The version of HM3.1 we examine in this analysis was released on March 3, 1997. According to the Hatfield Model sponsors, the following are among the changes that have been made to the model:[6]

- Inclusion of non-Bell territories
- Results can be displayed by wire center and/or density zone
- Additional density zones are considered
- CBGs are assigned to wire center based on an analysis of NPA/NXXs serving the wire center[7]
- Clustering is used to determine household locations within a CBG
- Estimates of residence and business lines have been refined
- New treatment of the number of distribution cables
- New estimates of 1995 census data from new vendor
- Drop length and network interface devices refined
- More extensive inclusion of general support investments

The following features are the same as HM2.2.2:

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[6] "Model Description, Hatfield Model Release 3.0," Hatfield Associates, Inc, February 7, 1997. Pages 7-11 provide a detailed summary of the changes from HM3.12.2.2.

[7] However, if the wire center assigned by this method is determined to be "too far" away relative to the closest wire center, the CBG is assigned to the closest wire center. This ignores reasons why the CBG may not be assigned to the closest wire center, such as LEC boundaries or geographical features.

- Structure sharing is still undocumented and is substantial
- Overhead loadings are based on a spurious "forward-looking" view
- Cost of money and depreciation rates are based on regulated conditions, not forward-looking competitive situations
- Switch costs are based on questionable data

Table 1 compares the average monthly cost per line for BCPM, BCM2, HM3.1 and HM2.2.2 for the five states we analyzed in our original evaluation. A weighted average (with relative number of lines serving as weights) is also displayed. The results for Table 1 are for runs using the default values of the respective models. Included in the monthly cost per line figure are loop, switching, and overhead costs.[8]

Table 1
Average Monthly Cost per Line

	AR	CA	TX	UT	WA	Wtd. Avg
Benchmark						
BCPM	$52.97	$28.78	$36.30	$36.42	$35.52	$32.62
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	AR	CA	TX	UT	WA	Wtd. Avg
HM3.1/ BCPM	-38%	-42%	-39%	-33%	-41%	-41%
HM2.2.2/ BCM2	-47%	-39%	-44%	-35%	-43%	-42%

[8]Transport and signaling costs are also included in the cost per line figures. HM3.1 explicitly models transport and signaling costs, while BCPM accounts for these costs with a factor applied to switching costs.

Compared to their predecessors, it can be seen that both the BCPM and HM3.1 produce average monthly costs per line that are approximately 20 percent greater. On average, per line costs for the HM3.1 are 41 percent less than average monthly per line costs for BCPM. This is about the same as the 42 percent average gap between HM2.2.2 and BCM2. Below, we analyze the primary sources of difference between the current versions of the models and the previous versions.

A. Sources of Change in BCPM Results Relative to BCM2

The reason that average monthly cost per line increased for BCPM relative to BCM2 can be traced to an increase in investment per line for BCPM. This is offset, to some extent, by a decline in the average annual cost factor (i.e., the conversion of investments into annual costs and the assignment of annual expenses and overheads) used in BCPM relative to that used in BCM2. Tables 2 and 3 detail the increase in investment per line, and Table 4 compares the implicit annual cost factors for the two versions of the model.

The increase in BCPM's investment per line relative to BCM2 can be attributed to an increase in average loop length and an increase in average switching investment per line. Table 2 compares BCPM and BCM2 total investment per line. The top panel of Table 2 shows that, on average over the five states, investment per line increased by 32 percent in BCPM relative to BCM2. The increases range from 27 percent in California to 52 percent in Arkansas. The middle and bottom panels of Table 2 break the comparison down into loop investment per line and switching and other investment per line. Loop investment per line has gone up an average of 11 percent over the five states. The increases range from 3 percent in California to 39 percent in Arkansas. As discussed below, this increase in loop investment is due to increases in loop length in BCPM. The bottom panel of Table 2 shows that per-line switching investment has increased substantially, from an average of $116 per line in BCM2 to $325 per line in BCPM.[9] The magnitude of this increase is similar across all five states. Appendix A provides more detail on switching costs.

Table 2
Comparison of BCPM and BCM2 Investments
Stated on a Per-Line Basis

Total Investment Per Line

	AR	CA	TX	UT	WA	Avg
BCPM	$2,506	$1,030	$1,486	$1,497	$1,441	$1,264
BCM2	$1,651	$814	$1,092	$1,155	$1,063	$959
% change	52%	27%	36%	30%	36%	32%

Loop Investment Per Line

	AR	CA	TX	UT	WA	Avg
BCPM	$2,079	$725	$1,142	$1,151	$1,104	$939
BCM2	$1,494	$706	$966	$1,071	$942	$843

Switch and Other Investment Per Line

	AR	CA	TX	UT	WA	Avg
BCPM	$427	$306	$344	$346	$337	$325
BCM2	$157	$108	$126	$84	$122	$116

[9] Switching investment also includes transport investment. As noted above, BCM2 and BCPM do not explicitly model transport investment, but estimates it by applying a factor to switching investment.

Table 3 analyzes the increase in loop investment in more detail. The top panel of Table 3 restates the loop investment per line from Table 2. The middle panel of Table 3 indicates an increase in average loop length for BCPM relative to BCM2. On average over the five states, average loop length increased 14 percent in BCPM relative to BCM2. The increases range from 5 percent in Arkansas to 17 percent in California and Washington. These increases are due to the change in CBG assignment methodology from the nearest wire center in BCM2 to the serving wire center BCPM.[10]

Table 3
Comparison of BCPM and BCM2 Loop Investments
Stated on a Per-Line Basis

Loop Investment Per Line

	AR	CA	TX	UT	WA	Avg
BCPM	$2,079	$725	$1,142	$1,151	$1,104	$939
BCM2	$1,494	$706	$966	$1,071	$942	$843
% change	39%	3%	18%	7%	17%	11%

Average Loop Length

	AR	CA	TX	UT	WA	Avg
BCPM	23,883	14,241	18,079	18,830	17,721	16,130
BCM2	22,793	12,194	16,118	16,675	15,199	14,142
% change	5%	17%	12%	13%	17%	14%

Loop Investment Per Foot

	AR	CA	TX	UT	WA	Avg
BCPM	$0.087	$0.051	$0.063	$0.061	$0.062	$0.058
BCM2	$0.066	$0.058	$0.060	$0.064	$0.062	$0.060
% change	33%	-12%	5%	-5%	1%	-2%

[10] This assignment is based on the location of the CBG's centroid relative to the wire center boundaries.